



United States
Department of
Agriculture

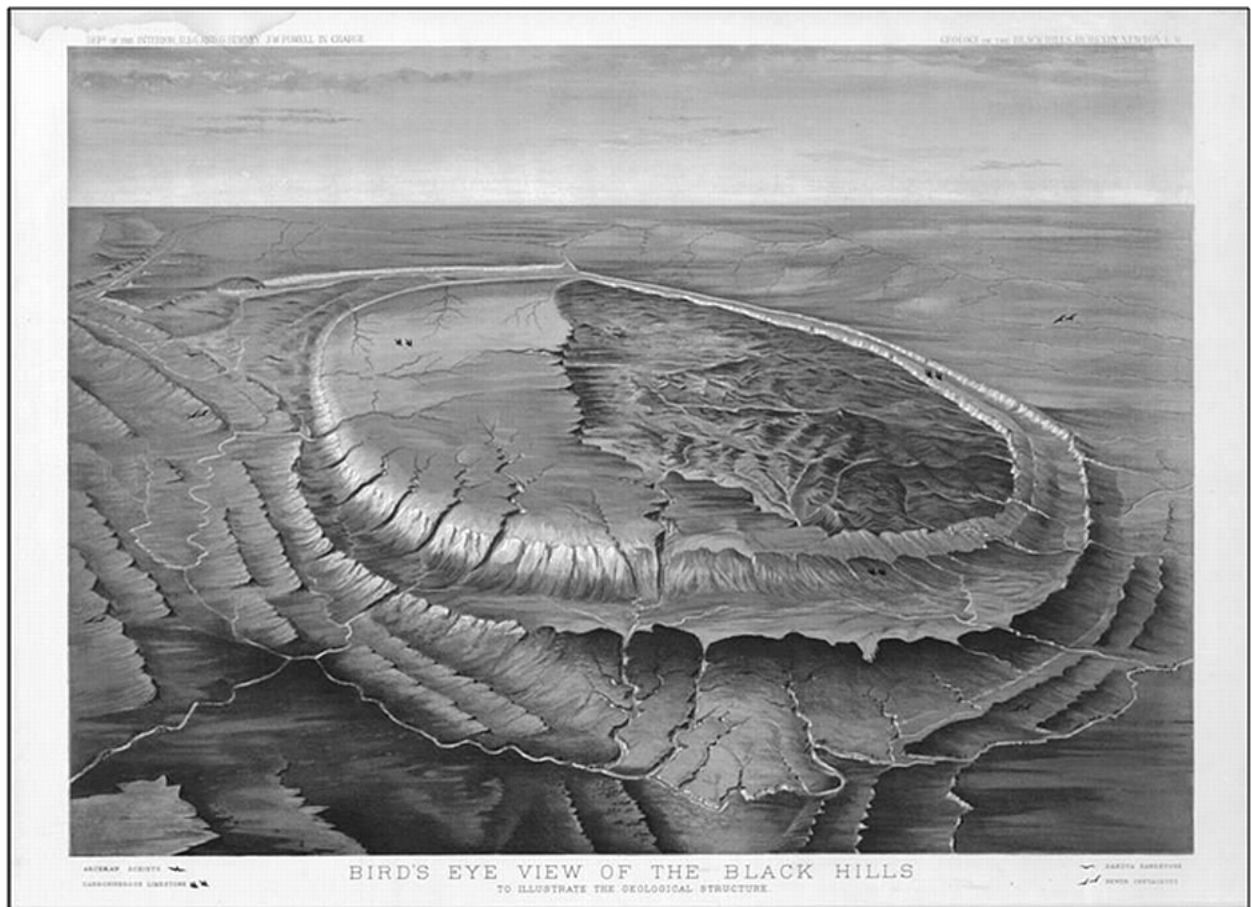
Forest
Service

May 2010



A Landscape Restoration Strategy for the Black Hills National Forest

An Island in the Plains



Bird's eye view of the Black Hills area as depicted by the 1875 Jenny-Newton survey. (From: Geology of the Black Hills by Henry Newton. Department of the Interior USG and G Survey, J.W. Powell in Charge. 1875)

For More Information Contact:

Dave Thom
Natural Resources Staff Officer
Black Hills National Forest
1019 North 5th Street
Custer, SD 57730
605-673-9200

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Table of Contents

I. Introduction.....	1
II. Collaboration	1
III. Restoration Objectives.....	2
IV. Ecological Restoration Treatments - a 10 year plan.....	2
V. The Black Hills National Forest - an "Island in the Plains"	3
A. Forests	4
B. Grasslands and Meadows	7
C. Fire Environment.....	8
D. Wildlife and Fish Habitat	9
E. Water	10
F. Socio-Economic Values.....	12
G. Transportation System	13
VI. Science Application - Incorporating the Best in Ecological Restoration	14
VII. Late-succession Forests	14
VIII. Fuel Treatments	15
IX. Conclusion.....	15
References	17
Map Appendix.....	19

I. Introduction

This landscape restoration strategy is prepared under the authority of the Omnibus Public Land Management Act of 2009¹, the Collaborative Forest Landscape Restoration Program (CFLRP). The intention is to expedite and more fully implement the land management objectives of the Phase II Amendment of the 1997 Revised Black Hills National Forest Land and Resource Management Plan (Forest Plan)². The Forest Plan provides direction for protecting communities, property, and other resource values and for conserving species by reducing fire and insect hazard and facilitating ecosystem recovery after fire or a similar event. The goals and objectives outlined in the Forest Plan provide an effective strategy for restoring ecological components and processes in a fire-adapted ecosystem, while also sustaining economic opportunities. The Forest Plan embraces recent science, broad public support and collaboration, and ecosystem principles.

This landscape strategy encompasses the entire Black Hills National Forest (1.2 million acres) and its intermingled and adjacent private and public lands. This strategy:

- embraces ecological, economic, and social sustainability;
- leverages local resources with national and private resources;
- facilitates reduction of wildfire management costs by reestablishing natural fire regimes and reducing the risk of uncharacteristic wildfire;
- demonstrates restoration techniques that achieve ecological and watershed health objectives,
- affects wildfire activity and management costs; and
- shows that forest restoration byproducts can offset treatment costs while benefitting local rural economies and improve forest health.

The broad framework of this strategy provides for specific individual projects that shift across the landscape as natural disturbances occur and affect natural resources or community values.

This strategy is consistent with the Forest Plan. It does not authorize new decisions, but is intended to assist with Forest-wide scheduling and budgeting and project-level planning and decisions.

II. Collaboration

The Forest Plan Phase II Amendment was prepared through a collaborative partnership with local, State, and tribal governments and other stakeholders. The South Dakota Departments of Agriculture and Game, Fish & Parks, and the Wyoming Departments of Game & Fish and Natural Resources, as well as seven counties in South Dakota and Wyoming were cooperators for the development of the Forest Plan. Twelve tribes, including the Lakota (Sioux), Cheyenne, Shoshoni, Crow and others, were consulted in Forest Plan development. Ongoing tribal consultation occurs on a project-by-project basis.

¹ <http://www.fs.fed.us/restoration/CFLR/documents/titleIV.pdf>

² USDA Forest Service. 2005. (<http://www.fs.usda.gov/blackhills>)

The National Forest Advisory Board³ was chartered in 2003 to provide input on land management issues on the Black Hills National Forest. The Advisory Board is comprised of 16 members representing a diverse mix of stakeholders. The Board was specifically consulted on and provided recommendations to the Forest Plan Amendment. On April 7, 2010 the Board reviewed the CFLRP, and based on subcommittee detailed review, made a final recommendation on April 21 to endorse the Phase II Forest Plan Amendment as meeting the intent of the CFLRP landscape strategy and to submit a proposal (with two parts) to the Regional Forester for FY10.

III. Restoration Objectives

The following objectives (some are paraphrased) taken from the Forest Plan serve as the strategy to move towards more natural processes in a fire-adapted ecosystem.

1. Manage 50-75% of the wildland-urban interface for moderate-to-low fire hazard and reduce fire hazard within proximity of structures... (Objective 10-01). Manage 50% of the remainder of the Forest, with some exceptions, to moderate-to-low fire hazard. (Objective MA 5.4A)
2. Where outbreaks of mountain pine beetle could present risks to management objectives for ponderosa pine, reduce acreage of ponderosa-pine stands that are in medium or high risk for infestation. (Objective 10-07)
3. Maintain or enhance hardwood shrub communities where biologically feasible, and within management objectives. (Objective 5.1-203)
4. Manage for varied structural stages in ponderosa pine across the management area in a variety of sizes and shapes. Ten percent of mature trees will be very large. Seek opportunities to increase shrubs. (Objective 5.1-204)
5. Provide variety in stand sizes, shape, crown closure, age structure, and interspersions. (Objective 5.1-202)
6. Manage for a minimum of 92,000 acres of aspen (double current aspen acres), and 16,000 acres of bur oak (approximately 33 percent increase). (Objective 201)
7. Manage for 122,000 acres of prairie grassland and 3,600 acres of meadow. (Objective 205)
8. Restore riparian shrub communities across the forest by 500 acres during the Plan period on sites capable of supporting this community. (Objective 214)
9. Prevent new infestations and manage to reduce established noxious-weed infestations. Treat at least 8,000 acres per year during the next ten years to limit noxious-weed infestations. (Objective 231)

IV. Ecological Restoration Treatments - a 10 year plan

A five-year plan for vegetation management is accomplished via project-level analysis. The schedule is displayed on Map A - Vegetation Planning Areas (2010-2014), Gate 3 and Current Timber Sales and 2009 Forest Health Survey, contained in the map packet. Projects are developed based on Forest-wide priorities, the highest being the mountain pine beetle epidemic

³ National Forest Advisory Board meeting minutes available at <http://www.fs.usda.gov/blackhills> (see “working together”, “advisory committees”)

and fuel treatments in the wildland-urban interface. Projects in years 6-10 will continue on a rotational schedule to be specifically determined in successive years.

The following treatments are necessary to meet the restoration objectives described above.

- **Thinning, overstory removals, and selection cuts** via commercial timber sales. Prescriptions include thinning-from-below, free thinning and overstory removals, some with reserves to create openings in the crown, increase spacing between trees, and release saplings. Result is anticipated to be increased tree vigor, increased tree size (diameter), more resistance to insect attack, and increased canopy height and reduced crown density (reduces probability of crown fire). Diversity will be enhanced by prescribed variation in tree spacing and size.⁴ Sanitation will remove the most urgent bark beetle infested trees when appropriate. Treat an estimated 20-25,000 acres annually and remove about 183,000 ccf of sawtimber annually and about 6,000 ccf of POL.
- **Pre-commercial thinning** of ponderosa pine saplings to increase tree growth and vigor and reduce fire hazard. Estimated area = 12-18,000 acres annually.
- **Fuel treatment.** Mechanical treatments to masticate, crush, lop/scatter or yard slash. Total *integrated* treatment approximately 50,000 acres/year.
- **Prescribed burning** including broadcast burns and pile burning. Effect will be to reduce ladder and surface fuels and improve vegetative diversity. Burns will also be used for controlling pine encroachment into grassland and meadows. Estimated treatment of 8-15,000 acres annually.⁵ Locate burns to meet strategic objectives to protect interface properties and resources, with limited financial resources.⁶
- **Enhance aspen clones** by pine removal and other potential silvicultural treatments. Estimated 300-500 acres per year.
- **Enhance riparian areas** gained by adaptive grazing practices, planting and protection. Estimated 10 acres per year.
- **Manage invasive weeds** by chemical and biological treatment before and after timber and fuel operations and by limiting overall disturbance. Estimated 8,000 to 10,000 acres annually.

V. The Black Hills National Forest - an "Island in the Plains"

The Black Hills of South Dakota and Wyoming and the Bearlodge Mountains of northeastern Wyoming are set apart from many ecosystems of the American West. Located in the Great Plains, the "Hills" are a host to eastern, Canadian relic, and western ecosystems. The ecologic, social and economic systems are briefly described, citing other sources for expediency.

⁴ See discussion Arno and Fiedler 2005, page 85 for an example.

⁵ Probably a conservative estimate of what is needed. Assuming 1,000,000 acres of pine on the Black Hills National Forest divided by an average 26 year fire return interval = 38,000 acres/year burned (see Arno and Allison-Bunnell, 2002, page 33). However, the modern Black Hills is crisscrossed with private lands and numerous improvements making such acreage impractical, but nonetheless provides a reference.

⁶ Control of the most destructive "heading" fires can be achieved without treating 100% of the acreage. Control has been achieved in simulations with as little as 20% carefully placed across the landscape; however, 50-60% would be needed with random fuel placement. See Finney, M.A. 2001. Design of regular landscape fuel treatment patterns for modifying fire growth and behavior. *Forest Science* 47: 219-228. Or, Finney, M.A. 2003. Calculating fire spread rates across random landscapes. *Intl. J. Wildl. Fire* 12(2):167-174. Or, Figure 19, page 30, Graham, McCaffrey and Jain, 2004. Rocky Mountain Res. Sta. GTR-120

A. Forests

The Black Hills are a forested island in a sea of prairie grass. The “island” concept is important because species associated with ponderosa pine, white spruce, and hardwood communities are susceptible to broad ecosystem change. The Black Hills contains plant communities from the Rocky Mountains, northern boreal forests, eastern hardwood forests, and the surrounding Great Plains. As an ecotone between the various communities, the Black Hills functions as a place for intermingling of species.

The Black Hills ecosystem is shaped by frequent low-severity fire, with infrequent stand-replacing fire (i.e., a mixed fire regime). Insect outbreaks occur on an approximate 20- to 30-year cycle. Stand-replacing fire has been a major component of the landscape since 2000, burning 15 percent of the Forest. Ecologically, this pattern may be consistent with what might be expected from large but infrequent events under the historic disturbance regime. However, stand-replacing fire is generally considered socially undesirable from the standpoint of human safety, effects to private and public property, and effects to the flow of goods and services from the Forest. In the last 100 years, fires of all types have been suppressed and, for social reasons, will continue to be suppressed when possible. Such active fire suppression has contributed to altering the function of the mixed-severity fire ecological system.

Current dense conifer forest conditions can be expected to contribute to the likelihood of additional large stand-replacing fires within the Black Hills ecosystem. Also, a variety of factors (including fire suppression and associated alterations to ecological systems) has contributed to changes in the function of some Black Hills ecosystem components or has reduced the



Adult mountain pine beetle in a “pitch tube” on ponderosa pine.



Photos taken in 1874 and 2007 show how forests in the Black Hills have grown denser due to decades of fire suppression

components. These include early succession ecological communities such as grassland and meadow communities, hardwood communities, beaver-dominated riparian communities, and areas of relatively open ponderosa pine with generally higher levels of understory diversity (Forest Plan Phase II Amendment FEIS p.II-1). As evidenced by the historical picture of 1874 and comparison picture of 2007, the Forest’s structure has changed to a denser, ponderosa pine forest.

The size of most of the trees on the Forest is less than 12 inches diameter breast height (Figure 1). The Forest is dominated by trees in the 80- to 120-year-old class (Figure 2).

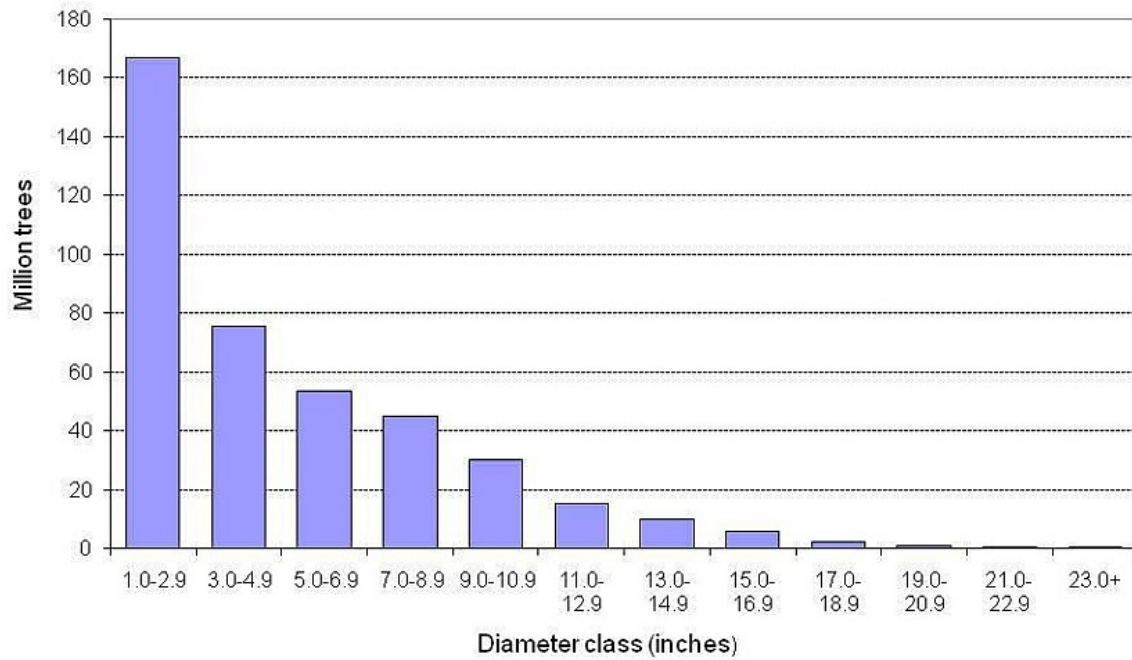


Figure 1 -- Number of live trees on forest land by diameter class, Black Hills National Forest, 1999.

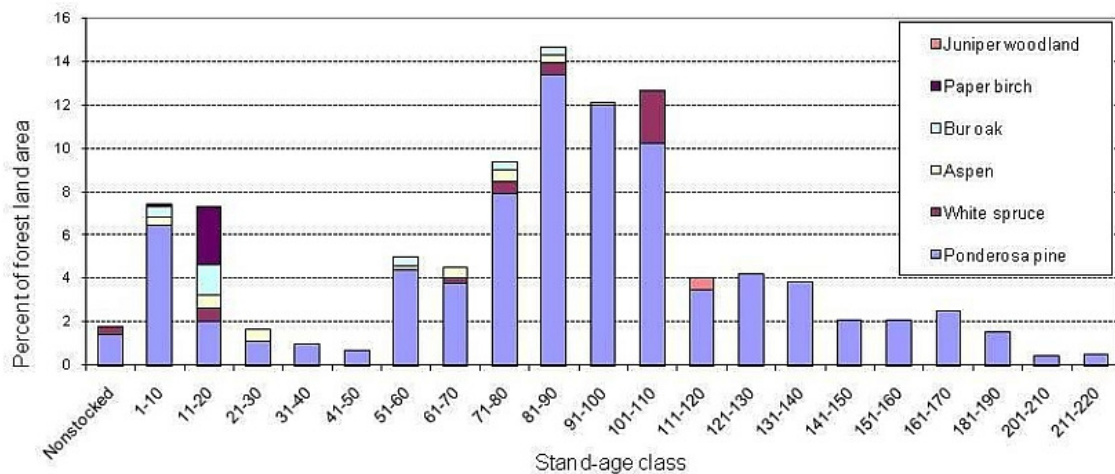


Figure 2--Percent of forest land area by forest type and stand-age class, Black Hills National Forest, 1999.

Generally, it is expected that fewer risks are associated with species viability within the planning area when there is a diversity of ecological conditions within the historical range of the species. The combination of broader geographical distribution and abundant ecological conditions generally contributes to the likelihood of species persistence.

The risks to species' long-term persistence are generally greater within a planning area when suitable ecological conditions are isolated or are in very low abundance. Such conditions limit the likelihood of population interactions between suitable environmental areas or patches, which may contribute to potential extirpations of species within areas or patches, and a low potential for natural re-colonization of such patches.

In the Forest Plan restoration strategy, vegetation structural stages are an indicator of the desired forest ecological condition. Ponderosa pine forest structure and condition, along with several other indicators such as understory shrubs, tree size and other species composition (hardwood, spruce, meadow, riparian, grassland, etc.) represent the forested ecosystem. The structural stages (SS) used are defined below:

- **SS1 (Grass/Forb):** An early forest succession stage during which grasses and forbs are the dominant vegetation. SS1 is defined as nonstocked, with a forest cover of less than 10 percent.
- **SS2 (Shrubs/Seedlings):** This is a developmental stage that is dominated by tree seedlings less than 1 inch diameter at breast height (d.b.h.) and shrub species.
- **SS3 (Sapling/Pole):** This developmental stage is dominated by trees 1 to 7 inches d.b.h., 10 to 50 feet in height and usually less than 50 years old. This structural stage is further broken down into three overstory crown closure classes to reflect different stand densities and habitat components
 - 3A - Crown closure of 10 to 40 percent
 - 3B - Crown closure of 40 to 70 percent
 - 3C - Crown closure of 70 to 100 percent
- **SS4 (Mature):** This structural stage consists of a tree component that is larger and older than those that make up SS3. SS4 is further broken down into three crown-closure classes to reflect different stand densities and habitat components.
 - 4A - Crown closure of 10 to 40 percent
 - 4B - Crown closure of 40 to 70 percent
 - 4C - Crown closure of 70 to 100 percent
- **SS5 (Late succession):** This structural stage is generally characterized by very large trees (very large trees are defined as a stand with an average stand quadratic mean diameter of 16 or more inches) and a general stand age of 160 years or more.



Structural Stage 4B stand with varied tree size and spacing

The focus of forest condition (also termed forest health) in the Forest Plan is fire hazard reduction. Reducing the fire hazard in ponderosa pine generally increases the resistance to

mountain pine beetle infestation. Ponderosa pine and white spruce plant communities cover approximately 83 percent and 2 percent,, respectively, of the Black Hills National Forest; various structural stage conditions of these communities contribute to the primary fire hazard concern on the Forest.

B. Grasslands and Meadows

Grassland and shrubland ecosystems (often referred to as rangelands) are defined as upland plant communities dominated by herbaceous and/or shrubby vegetation with less than 10-percent tree cover. The most recent estimate of area covered by grasslands on the Black Hills is approximately 110,000 acres (USDA Forest Service 2005). Shrublands typically occupy transitional zones between forested and grassland ecosystems. Vegetation in these ecosystems consists primarily of low-growing plants such as grasses, grass-like plants, forbs, and shrubs. Various types of wildlife depend on grassland and shrubland ecosystems for forage and cover throughout the year (USDA Forest Service 1996, p. III-173).

The same types of grassland and shrubland ecosystems that existed in the Black Hills prior to Euro-American settlement can still be found today. One change that has been ascertained with some certainty is that the historical forest/prairie interface of the Forest was higher in elevation due in part to a higher frequency of low-intensity fires (Brown and Sieg 1999; USDA Forest Service 1996, p. III-148). These fires had the effect of limiting pine encroachment into adjacent prairie grasslands by “thinning” seedlings and saplings. After a century of fire suppression and forest management, ponderosa pine forests are denser and more extensive. Understory productivity is diminished, acreage of interior prairies and meadows is reduced, and community diversity is simplified (Parrish et al. 1996). Similarly, it is likely that shrublands were more widely distributed and abundant during presettlement times (USDA Forest Service 1996, p. III-149).



Low-intensity fire burns across a grassland

There are no federally threatened, endangered, or proposed plant species or designated critical habitat on the Black Hills National Forest. The only candidate plant species known to occur on the Black Hills National Forest, narrowleaf grapefern (*Botrychium lineare*), was officially removed from the candidate list in 2007 (USDI Fish and Wildlife Service 2007). However, narrowleaf grapefern remains on the Region 2 sensitive plant list.

The Black Hills National Forest has confirmed occurrences of 13 Region 2 sensitive plant species as well as 11 plant species of local concern. The list of Region 2 sensitive species is a dynamic list and was last updated in 2009 (USDA Forest Service 2009). The species of local concern list was designated in the Forest Plan in 2006.

The Black Hills National Forest Invasive Species Action Plan (USDA Forest Service 2008) lays out background, concerns, priorities, and needs for the management of invasive species. Specifically, the action plan provides a short history of treatments and a review of the Forest priorities and needs for weed treatments over the next 3 years. The document is updated every 1 to 2 years or as the need arises.

Invasive weeds have infested over 180,000 acres of the Black Hills National Forest. There are 21 major species of invasive (noxious) weeds on the Black Hills in South Dakota and Wyoming. Noxious weeds are aggressive invaders of the natural plant communities that reduce forage available for wildlife and livestock and alter fire and watershed regimes. The Forest Plan objective is to treat at least 8,000 acres annually; treatment has exceeded that level since 2003. Additional funding to adequately treat noxious weeds is badly needed.

C. Fire Environment

Course-scale national data (Schmidt et al. 2002) characterized the Black Hills as primarily fire regime condition class III. A fire regime condition class (FRCC) is a classification of how much the current fire regime has departed from the natural (historical) fire regime. A FRCC 3 is a high departure from the natural regime. Forest conditions over much of the range of ponderosa pine in the Black Hills exhibits conditions (hazard) that may result in severe crown fire. A subjective classification of these conditions indicates that most forested landscapes would be characterized as condition class II (moderate departure) or III depending on the relative abundance of the vegetation classes, landscape positions (northern vs. southern Black Hills) and the mix of surface and stand-replacing fires for those landscapes. Restoration of open, low-density forest stands and surface fire regimes over portions of the Black Hills landscape is desirable to meet ecological objectives.

The fire return interval ranges from about 11 years in the southern part of the Forest to 40 years in the northern part, with an average of about 26 years. The mixed-severity fire regime and associated variability in fire effects is consistent with the Black Hills fire history reconstruction that lead to conclusions about the occurrence of frequent, low-severity surface fire with infrequent, high-severity stand-replacing fire (Brown and Sieg 1996, Shinneman and Baker 1997, Brown and Sieg 1999, Brown et al. 2000, Arno 2000, Brown 2003). In summary, these studies would indicate that the fire regime in the forested areas of the Black Hills might be best described as a mixed-severity fire regime (10 - 100 or more years).

The trend in fire hazard⁷ is shown below.

Table 1. Acres of land in the Black Hills National Forest by fire hazard rating

Year	Low	Moderate	Low+Mod	High/Very High	High/Very High	Total
1995 (baseline)	23,669	509,578	43%	696,524	57%	1,229,771
2006	108,365	421,218	43%	712,459	57%	1,242,042
2007	108,345	398,984	41%	734,783	59%	1,242,112
2008	104,874	437,737	43%	706,457	57%	1,249,068

Note: Includes all cover types, structural stages, and management areas. Difference in total acres may be due to land acquisitions, trades, and data refinement.

Fire hazard has remained largely unchanged since 1995. Current fire hazard is displayed on Map B – Black Hills National Forest – Fire Hazard Rating (May 5, 2010). Fuel treatments reduce fire hazard, but over time, increasing tree density moves areas previously rated as “low to moderate”

⁷ Explained in Phase II Amendment FEIS, Appendix B-13, 14. October 2005. Data from FY2008 Forest Monitoring and Evaluation Report.

up to” high and very high” ratings (roughly a 2 percent increase in areas rated as high/very high from the baseline of 1995). Analysis of fire hazard will continue.

From 1970 to 2009, the Black Hills National Forest has averaged 130 fires per year with an average of 6,021 acres burned each year. Crown fires are generally considered the primary threat to ecological and human values and are the primary challenge for fire managers (Peterson et al. 2003).

There are currently 56 at-risk communities as recognized in the Federal Register. These communities range in size from small, isolated rural enclaves to small towns and cities. The Black Hills National Forest lies in or immediately adjacent to five counties (Meade, Lawrence, Pennington, Custer and Fall River) in South Dakota and two (Crook and Weston) in Wyoming. Each of these counties has an approved community wildfire protection plan (CWPP) that identifies those areas most in need of vegetation management treatments. See Map D – Wildland-Urban Interface (WUI), May 5, 2010, or



Fuel reduction - thinning and hand piling for later burning or chipping.

(<http://www.fs.usda.gov/blackhills>) (Land and Resource Management/CWPPs).

The vegetation management program on the Black Hills National Forest is a well-balanced and efficient program that accomplishes roughly 52,000 acres per year of integrated fuel treatment. This program utilizes mechanical (both commercial and pre-commercial) activities in conjunction with prescribed fire to meet Forest Plan objectives.

Large, destructive wildland fires are evident throughout the Black Hills National Forest. From 2000 to 2007 an estimated 183,803 acres of National Forest System lands burned. The Jasper Fire covered about 61,000 acres in one afternoon. Other fires, exacerbated by dry conditions, have burned up to 12,000 acres in a single 8-hour burning period. The Grizzly Gulch Fire at 11,600 acres destroyed homes on the edge of Deadwood, SD and forced the evacuation of thousands of residents and visitors in this major tourism-destination community. These fires affected local communities, economies, ecosystem components, and forest visitors. See Map C – Large Fire History, 1910-2009.

D. Wildlife and Fish Habitat

The Black Hills are an ecological crossroads that includes characteristics of eastern deciduous forests, rocky mountain pine forests, northern boreal forests and the surrounding Great Plains. This diversity of habitats promotes a corresponding diversity of wildlife species. There are no federally listed threatened or endangered species on the Forest. Private inholdings fragment the land ownership, especially along the stream network. Twelve Forest Service impoundments provide recreational fishing opportunities.

The Norbeck Wildlife Preserve covers 35,000 acres, of which 28,000 acres are on the Forest, including all of the Black Elk Wilderness. The Norbeck Wildlife Preserve was established by Congress in 1920 for the "protection of game animals and birds and to be a breeding place...".

Several species, including ruffed grouse (a Forest management indicator species), are closely tied to aspen stands. Ruffed grouse use a variety of aspen structural stages, including late-succession stages for drumming and other stages for buds and catkins. Deer and elk also use aspen for browse and screening cover during different times of the year. Aspen have slowly been replaced by pine in the absence of fire.

Large trees provide habitat for many species. Turkeys often use large trees with large branches for roosting. Brown creepers (a Forest management indicator species) are found most abundantly in old coniferous and mixed-coniferous-deciduous forests. Brown creepers prefer to nest in mature or old forest with a fairly closed canopy and glean insects off the bark of large trees. This mature pine habitat is prone to wildfires and insects if understory trees become too dense and the areas are not managed across the landscape.



Aspen stands are an important habitat component for ruffed grouse

Raptors need trees large enough to support their nests. Some raptors, such as northern goshawks (a Region 2 sensitive species), prefer relatively dense forested areas for nesting and a variety of ages and structure types for foraging. These densely forested areas are susceptible to wildfire and insects if not managed in a sustainable condition.

In general, the diversity of wildlife species in the Black Hills require a diversity of cover types, tree sizes, structural components, successional stages, and understory components to provide their habitat requirements.

E. Water

The Black Hills area has a continental climate, which is characterized generally by low precipitation amounts, hot summers, cold winters, and extreme variations in both precipitation and temperatures. Generally, lower temperatures and higher precipitation occur at the higher altitudes. Average precipitation is about 19 inches. About 92 percent of the annual precipitation is returned to the atmosphere via evapotranspiration. About 3.5 percent of annual precipitation recharges groundwater aquifers in the area and about 4.5 percent of the annual precipitation becomes surface runoff.

The Black Hills are drained by many streams, which radiate from the divide formed by the Limestone Plateau. The water from the Black Hills eventually drains into either the Belle Fourche or Cheyenne Rivers, which then drain into the Missouri River. There are no naturally occurring lakes in the Black Hills or the Bearlodge Mountains. There are numerous groundwater-dependent ecosystems within the Black Hills.

No single general statement can be made for historical or current surface water flows in the Black Hills because they are highly influenced by geology and climatic conditions.

The timing of stream flow volumes in the Black Hills has likely changed. Several factors may have led to this alteration. One factor is that a specific ecosystem component, beaver, were more abundant in the Black Hills than they are now. These animals built small dams on many Forest streams, contributing to the formation of small lakes and marshy areas (acting as slow release sponges) behind the dams. Often the slow release of water below dams contributed to perennial flow conditions as compared to otherwise seasonal flows. The dams also contributed to water table elevations and wet meadow conditions. Suitable beaver habitats are generally low gradient streams near aspens or willows. The acres of aspen and willows are less than the desired condition identified in the Forest Plan.



Beaver dams have been a key ecosystem component of streams in the Black Hills

The generally saturated moisture content of soils in the riparian areas and meadows contributed to preventing the general invasion of ponderosa pine (and other conifers) into these areas. The higher water tables and delayed release of stream flow increased the perception of overall higher surface water yield. Since the Black Hills have been opened for settlement, the streams and associated riparian areas (including willow stands), meadows, hardwood stands (including aspen stands) have been altered to support a myriad of human uses, including mining, livestock water supply and use, irrigation, timber production with associated access roads, and recreation. Today, people are more dependent than ever on water supplies for residential, municipal, and industrial use.

The Forest Plan Phase II Amendment EIS identified that the general location of wetlands and riparian areas in valley bottoms or depressions and wetter site conditions make them less prone to extensive high-intensity wildfire. Because riparian vegetation is generally more resistant to wildfire than other vegetation, it is likely that fires in riparian areas would be of less severity.

Healthy forest watersheds maintain a dynamic balance within a limited range of soil and stream conditions. Wildfires and floods occur in natural cycles in the pine forests of the West. On rare occasions, these natural disturbances can be severe and throw even healthy forest watersheds out of balance. Resilient watersheds usually recover in a few years.

If the ground cover of plants and litter is sustained, rain and snow infiltrates the soil to be filtered and released as clean water to streams, and watershed function is conserved. Loss of ground cover increases surface runoff and erosion, which can impair watershed function and stream health.

Approximately 81,000 acres or less than 1 percent of the lands administered by the Black Hills National Forest is estimated as riparian (moist zones along streams) or wetland habitat (bogs, marshes, fens, and meadows). These riparian and wetland systems cover the range from high to low elevation. Higher elevation systems are characteristic of cooler, boreal relict systems. Lower elevation systems are transitional habitat from the mountains to the prairie. Some locations have site characteristics that are not found elsewhere in the Black Hills.

These riparian and wetland habitats can be some of the most productive and biologically diverse lands on the Forest and can provide living conditions for a greater variety of aquatic and

terrestrial wildlife than most any other habitat type if conditions (or “health”) of a majority of the areas were improved. Wetlands and riparian areas are the "super-sponges" of a watershed that store and purify vast amounts of water. It is well known that when in high-quality condition, having the characteristics of a greater "sponge capacity", wetland and riparian systems can contribute to higher water table elevations and longer on-site water retention, which can then contribute to the greatest extension of stream flows later into the growing season.

Forest watersheds are considered more crucial than ever as population growth puts more demand on water supply, and climate change and forest fires make the quantity and quality of that supply less certain.

F. Socio-Economic Values

Forest Products

Helping sustain jobs, income, and a local industry is an important component of this 10-year strategy because this infrastructure and related jobs provide a cost-effective means to reach Forest management objectives, including species habitat objectives. The Black Hills National Forest supports a number of commercial industries that utilize the various forest products it contains including sawtimber, posts and poles, and wood chips (biomass).

The Black Hills National Forest harvested over 112 million board feet in FY 2009. There is one principal sawtimber purchaser on the Forest, Neiman Timber Company. Other smaller operators occasionally purchase sawtimber sales.

Timber West, located in Rapid City, South Dakota is the principal purchaser of POL (products other than logs), which equates to post and pole products.

Baker Timber Products at Rockerville, South Dakota, chips sawtimber boom-delimber piles and POL slash piles into chips for delivery to Dakota Panel at Rapid City, SD, the STAR Academy at Custer, SD, and KL Energy at Upton, Wyoming.



A number of commercial industries utilize the various forest products available from the Black Hills including sawtimber, posts and poles, and wood chips (biomass).

The Black Hills National Forest actively treats forest lands to reduce fire and insect hazard and to meet timber sale and other objectives of the Forest Plan. Objective 303 of the Forest Plan identifies a sawtimber level of 181,000 ccf and products other than logs (POL) equal to 21,000

ccf. Sawtimber and POL sales generate approximately 187,024 green tons (50 percent moisture content) of biomass annually.

Tree harvesting treatments result in waste wood, or "biomass", that has had limited market value and requires considerable expenditure to reduce or remove. There are opportunities to use biomass in various ways including co-generation, ethanol, and other secondary wood products (usually chipped). Markets need to be developed. The photos on page 12 show treetops available for utilization as biomass and biomass being chipped.

Employment and Training

Total forest industry employment in the Black Hills is approximately 1,500 jobs. Although not precise, it could be separated into an estimated 913 to 1,328 (direct and indirect) jobs from sawtimber sales, and an estimated 92 direct and indirect jobs from the small-diameter market. The jobs maintained or created are typically full-time, year-round and permanent, some with employment benefits. Even during recent lumber market declines, local producers have retained most employees reflecting interest and dedication to their workforce. Employment or training opportunities is provided for these jobs. Local producers provide training under the Central Rockies Sustainable Forestry Education Program. Training has been provided to workers employed or contracted in emerging small-diameter timber markets.

All contractors or wood-processing facilities in the Black Hills are qualified small businesses under various authorities within the Small Business Administration. Several are women or minority (8a) owned. It is anticipated these trends will continue.

Youth Employment and Training

The Youth Natural Resources Program (Youth Conservation Corps authority) employs and trains 15 to 20 youth enrollees annually in cooperation with the National Park Service (Devil's Tower and Mt. Rushmore National Memorials), Boxelder Job Corps, and the Standing Rock, Cheyenne River, Yankton and Oglala Sioux Tribes.

Recreation and Tourism

Recreation and tourism activities are an important part of the Black Hills area economy. Significant national attractions occur locally in the form of Mt. Rushmore National Memorial, Wind Cave National Park, Jewel Cave National Park, and Devils Tower National Monument. Custer State Park (71,000 acres) provides scenic and recreational opportunities adjacent to the Black Hills National Forest. The ongoing carving of the Crazy Horse Memorial north of Custer, SD is a popular tourist attraction.

G. Transportation System

The Black Hills National Forest has an extensive road network. This provides access to carry out land management activities such as thinning and fuels reduction. It also facilitates the transport of forest products to local area industries for economic sustainability. The system can accommodate biomass hauling (chip vans) in most locations, which to date has not limited biomass or chips removal. A Forest-wide travel management decision designating routes open to motorized vehicle use was recently signed in compliance with the 2005 Travel Management Rule. Opportunities for restoration exist both on the designated motor vehicle routes open to the public as well as those routes open only for emergency or administrative use. All temporary roads

constructed to carry out ecological restoration activities identified in the attached proposal would be closed or decommissioned via contract requirements, roads (CMRD) funds, timber sale revenues collected under the Knutson-Vandenberg Act (KV) funds, or Collaborative Forest Landscape Restoration Program funds.

VI. Science Application - Incorporating the Best in Ecological Restoration

This 10-year strategy, which is guided by the Forest Plan, incorporates the best available science. In integrating the biological and social sciences, the Forest Plan considered the following:

- The role of fire, insects, and other disturbances in the ecosystem
- The scientific literature and its application in alternative analysis
- The role of social sciences

The planning team and specialists that wrote the Forest Plan consulted with Forest Service research scientists, the U.S. Fish and Wildlife Service, State universities, State fish and game agencies in Wyoming and South Dakota, and others. Early in the process, 41 species conservation assessments (technical papers) were prepared specific to the Black Hills, and other regional assessments were consulted to gather the latest scientific information. Panels of scientists with varying perspectives on selected topics were assembled in 2005 to review information, analysis, and conclusions as part of a science consistency review.

VII. Late-succession Forests

Late-succession forest is typically identified as timber stands averaging over 16 inches in diameter and older than 160 years. There are two types of late-succession ponderosa pine forest defined for the Black Hills. The first type, open-canopy late-succession ponderosa pine, occurs where periodic, low-intensity fires have been part of the ecosystem. These late-succession stands consist of clumps or groups of trees with grasses in the openings between the clumps. They would contain large old trees with open branches, irregular, and flattened crowns. The clumps or groups of trees would contain little down dead material and few small trees.

The second type, closed-canopy late-succession ponderosa pine forest occurs where periodic, low-intensity, high-frequency fires have not been a significant part of the ecosystem. These stands would contain large old trees with open branches and irregular crowns. The stands would have multiple canopy layers made up of various-aged trees. They would be well stocked with trees and contain standing dead and down trees.

Forest Plan management area objectives (Objectives 4.1-203, 5.1-204, 5.4-206, 5.43-204 and 5.6-204) are to have 5 percent in the *late succession* structural stage. Objective 3.7-201 in the Late-Succession Forest Management Area strives to manage each contiguous unit within this management area



Late successional, uneven-aged ponderosa pine

as a late-succession landscape, so that late-succession structure is always present within some portion of each unit.

Currently, the percentage of late-succession forest is well below the objectives both Forest-wide and by management area. Detailed accounting can be found in the most recent Forest Plan Monitoring and Evaluation Report available at:

http://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5112255.pdf

VIII. Fuel Treatments

Forest Plan Goal 10 that guides this restoration strategy is to establish and maintain a mosaic of vegetation conditions to reduce occurrences of catastrophic fire, and insect and disease outbreaks, and to facilitate firefighting capability. To accomplish this goal, Objective 10-01 identifies a desired condition to manage for a 50 to 75 percent moderate-to-low-fire hazard in the wildland-urban interface.

In fiscal year 2008, the fire hazard on the Black Hills was reduced on 80,020 acres through tree thinning, timber harvest, forest health, and wildlife and range management projects.

Aggressive fuel treatments to thin trees, convert some pine stands to hardwoods, and treat ground fuels must continue to keep ahead of continuously increasing fire hazard as the seedlings establish and forested areas grow and become denser. Treatments must include a combination of mechanical treatments to remove excess forest fuels and thin trees, followed by prescribed fire to remove smaller fuels and encourage fire resistance in trees. Large trees are retained and small trees removed in thinning-from-below prescriptions. A secondary benefit is anticipated to include improved forage and vegetative diversity.



A low-intensity prescribed burn follows treatments that thin trees and remove excess forest fuels

IX. Conclusion

The Forest Plan for the Black Hills National Forest guides this 10-year strategy for ecological restoration. The Forest Plan was amended in 2005 to better protect national forest resources, public safety, and adjacent private property while providing for species viability.

The following strategic actions are recommended and deemed consistent with the Forest Plan:

1. Prioritize commercial timber sales in areas of highest risk for mountain pine beetle infestation to create more open-growing stands, and where feasible, timely and appropriate, sanitize stands to remove beetle-infested trees.

2. Restore a generally more open forest with larger trees, younger and late-successional trees, with irregular tree spacing and a mix of patch sizes through commercial timber sales. Continue using various prescriptions including an increasing look at selection systems.
3. Continue fire hazard reduction treatment across the landscape and particularly within the wildland-urban interface near at-risk communities. Tools should include prescribed fire and mechanical treatments, often using several treatments on a given acre to restore ecological processes. Strive for 10,000 - 15,000 acres of extensive prescribed fire annually, while first providing for safety, property protection, and program quality.
4. Restore long-term watershed health by promoting resilient ecosystem processes, reduced intensity of wildfire, and enhanced riparian areas.
5. Develop specific Forest-wide actions to increase acreage of aspen.
6. Work with applicable agencies, organizations and businesses to remove and utilize biomass remaining after timber sales and other forest management projects.
7. Forest management will foster a sustainable level and mix of employment and development opportunities, including youth programs.
8. Maintain where applicable forest plan objectives for scenic quality.
9. Consider an “all lands” approach in applying restoration objectives in active coordination with other agencies and landowners.

References

- Arno, S.F. 2000. Fire regimes in western forest ecosystems. Pages 97-120 in J.K. Brown, ed., Effects of fire on flora. USDA Forest Service, Rocky Mountain Research Station, Gen. Tech. Report RM-42, vol. 2, Fort Collins, Colorado.
- Arno, S.F. and Allison-Bunnell 2002. *Flames in our Forest – Disaster or Renewal?* Island Press, Washington, DC.
- Arno, S.F. and Carl Fiedler. 2005. *Mimicking Nature's Fire*. Island Press, Washington, DC.
- Brown, P.M. 2003. Fire, climate, and forest structure in ponderosa pine forests of the Black Hills. PhD Dissertation, Colorado State University, Fort Collins. 103pp.
- Brown, P.M. and C. Hull Sieg. 1996. Fire history in interior ponderosa pine communities of the Black Hills, South Dakota, USA. *Int. J. Wildland Fire* 6(3): 97-105.
- Brown, P.M. and C.H. Sieg. 1999. Historical variability in fire at the ponderosa pine – northern Great Plains prairie ecotone, southeastern Black Hills, South Dakota. *Ecoscience* 6(4): 539-547.
- Brown, P.M., M.G. Ryan and T.G. Andrews. 2000. Historical surface fire frequency in ponderosa pine stands in research natural areas, central Rocky Mountains and Black Hills, USA. *Natural Areas Journal* 20:133-139.
- Parrish, J.B., D.J. Herman, D.J. Reyher, and Black Hills National Forest. 1996. A century of change in the Black Hills forest and riparian ecosystems. USDA Forest Service Agricultural Experiment Station, USDA, South Dakota State University. 13p.
- Peterson, D.L., Agee D.L., Jain, T., Johnson, M., McKenzie, D., and Reinhardt, E. 2003. Fuels planning: managing forest structure to reduce fire hazard. Proceedings of the 2nd International Wildland Fire Ecology and Fire Management Congress. American Meteorological Society. Boston, Massachusetts.
- Schmidt, K.M., J.P. Menakis, C.C. Hardy, W.J. Hann, and D.L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41pp. + CD
- Shinneman, D.J. and W.L. Baker. 1997. Nonequilibrium dynamics between catastrophic disturbances and old growth forests in ponderosa pine landscapes of the Black Hills. *Conservation Biology* 11(6):1276-1288.
- USDA Forest Service. 1996. Black Hills National Forest 1997 revised Land and Resource Management Plan. USDA Forest Service. Custer, South Dakota.
- USDA Forest Service. 2005. Phase II Amendment and Final Environmental Impact Statement for the 1997 Land and Resource Management Plan. Black Hills National Forest, Custer, South Dakota.
- USDA Forest Service. 2008. Black Hills National Forest Invasive Species Action Plan. http://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5112190.pdf

- USDA Forest Service. 2009. Region 2 Regional Forester's Sensitive Species. [Online] <http://www.fs.fed.us/r2/projects/scp/sensitivespecies/index.shtml> Accessed April 21, 2010.
- USDA Forest Service. 2009. FY2008 Forest Monitoring and Evaluation Report. Black Hills National Forest, September, 2009. Custer, South Dakota.
- USDI Fish & Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Federal Register. Vol. 72 No. 234. 69034.
- USDI Fish & Wildlife Service. 2009a. USFWS Threatened and Endangered Species System (TESS) for South Dakota. [Online] Accessed January 12, 2009. http://ecos.fws.gov/tess_public/pub/stateListingAndOccurrence.jsp?state=SD
- USDI Fish & Wildlife Service. 2009b. Plants of the Mountain Prairie Region. [Online] <http://www.fws.gov/mountain%2Dprairie/species/plants/> Accessed January 12, 2009.
- USDI Fish & Wildlife Service. 2009c. USFWS Threatened & Endangered Species System for South Dakota: Proposed Species. [Online] Accessed January 12, 2009. http://ecos.fws.gov/tess_public/pub/stateListing.jsp?state=SD&status=proposed
- USDI Fish & Wildlife Service. 2009d. USFWS Threatened & Endangered Species System for South Dakota: Candidate Species. [Online] Accessed January 12, 2009. http://ecos.fws.gov/tess_public/pub/stateListing.jsp?state=SD&status=candidate

Map Appendix

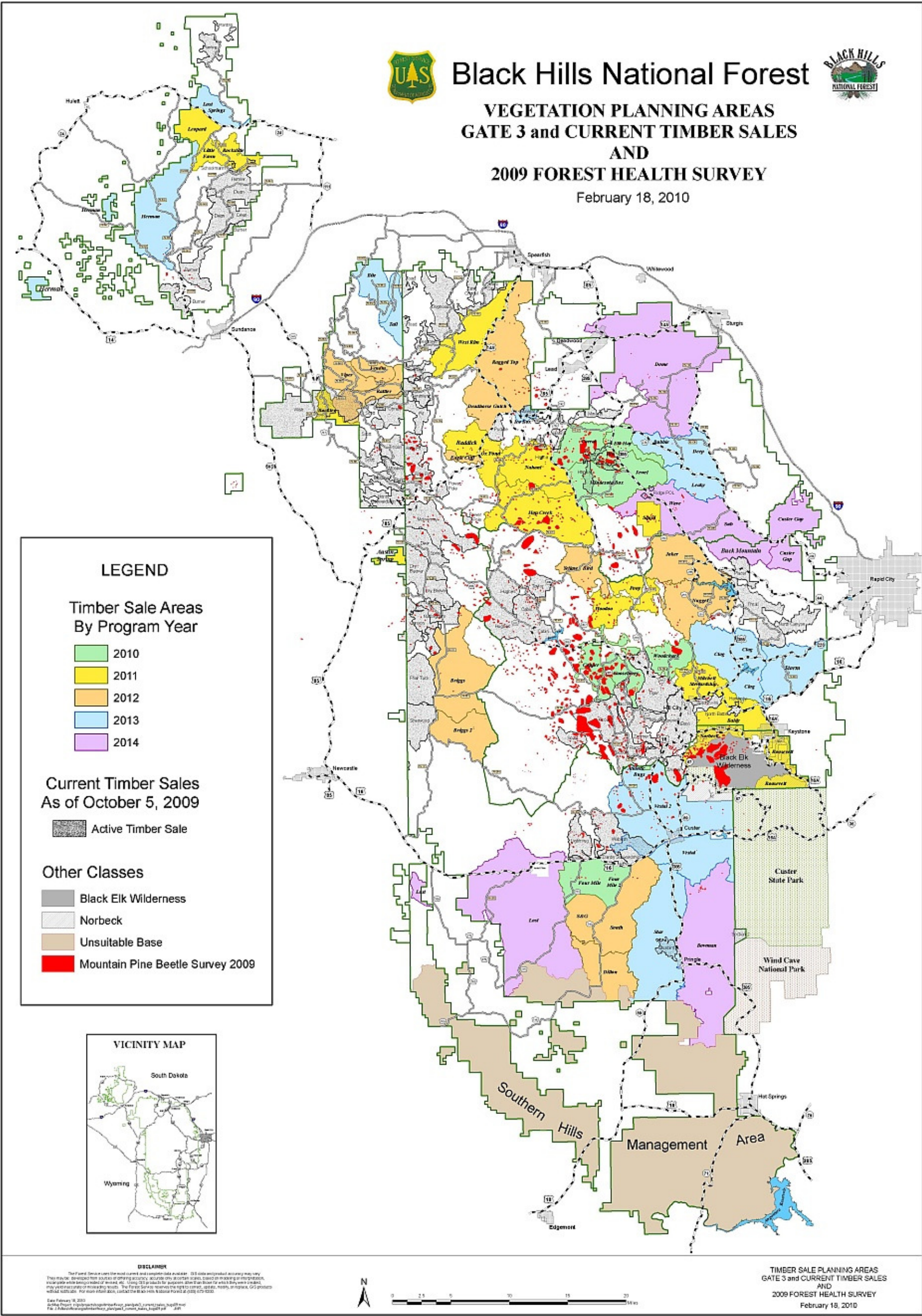
NOTE: The following maps must be printed single-sided on 11 x17 inch paper. They may also be viewed and printed in a larger format from the following website: <http://go.usa.gov/iuW>

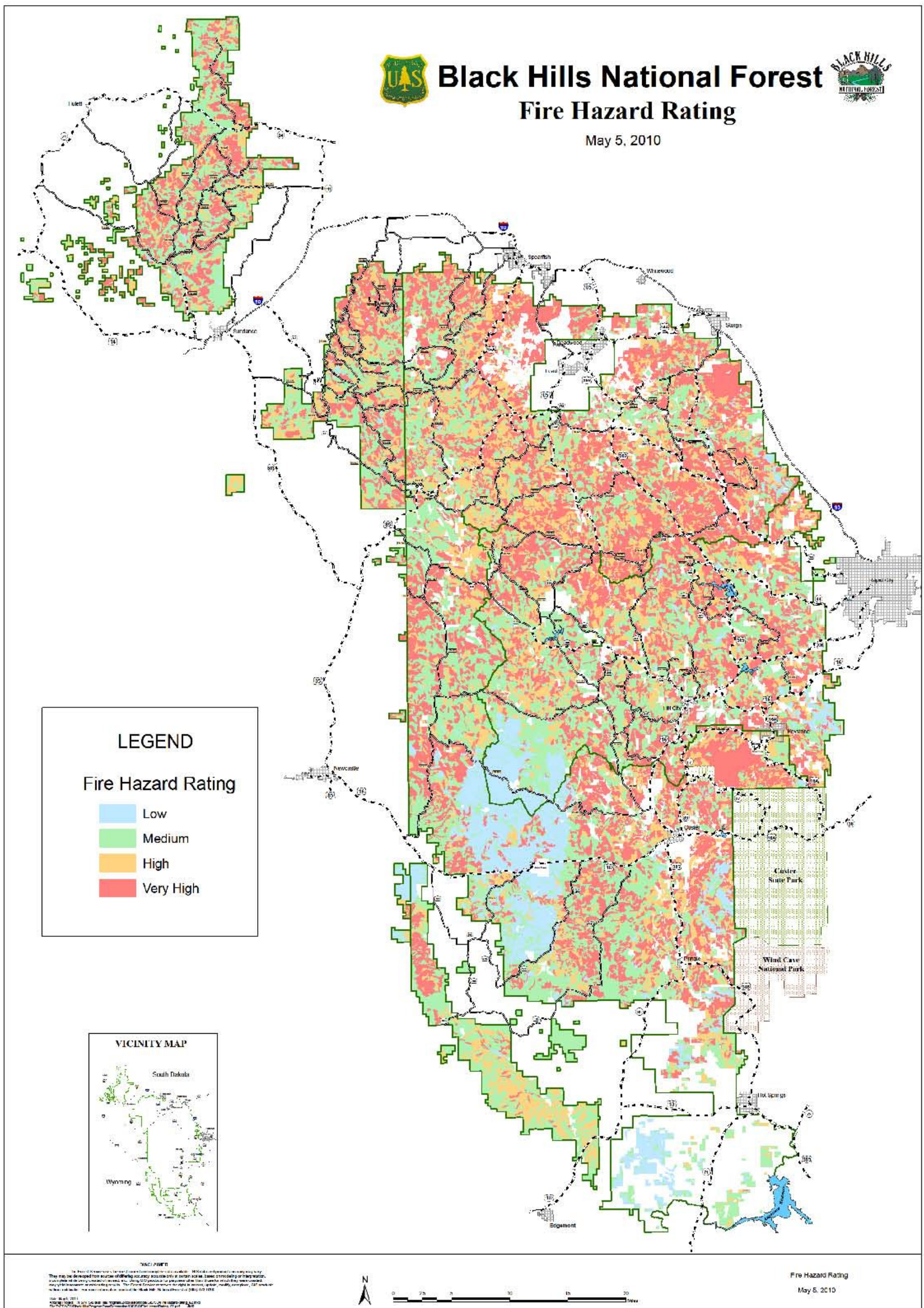
Map A – Vegetation Planning Areas, Gate 3 and Current Timber Sales and 2009 Forest Health Survey (2010-2014). (February 18, 2010).

Map B – Black Hills National Forest – Fire Hazard Rating (May 5, 2010)

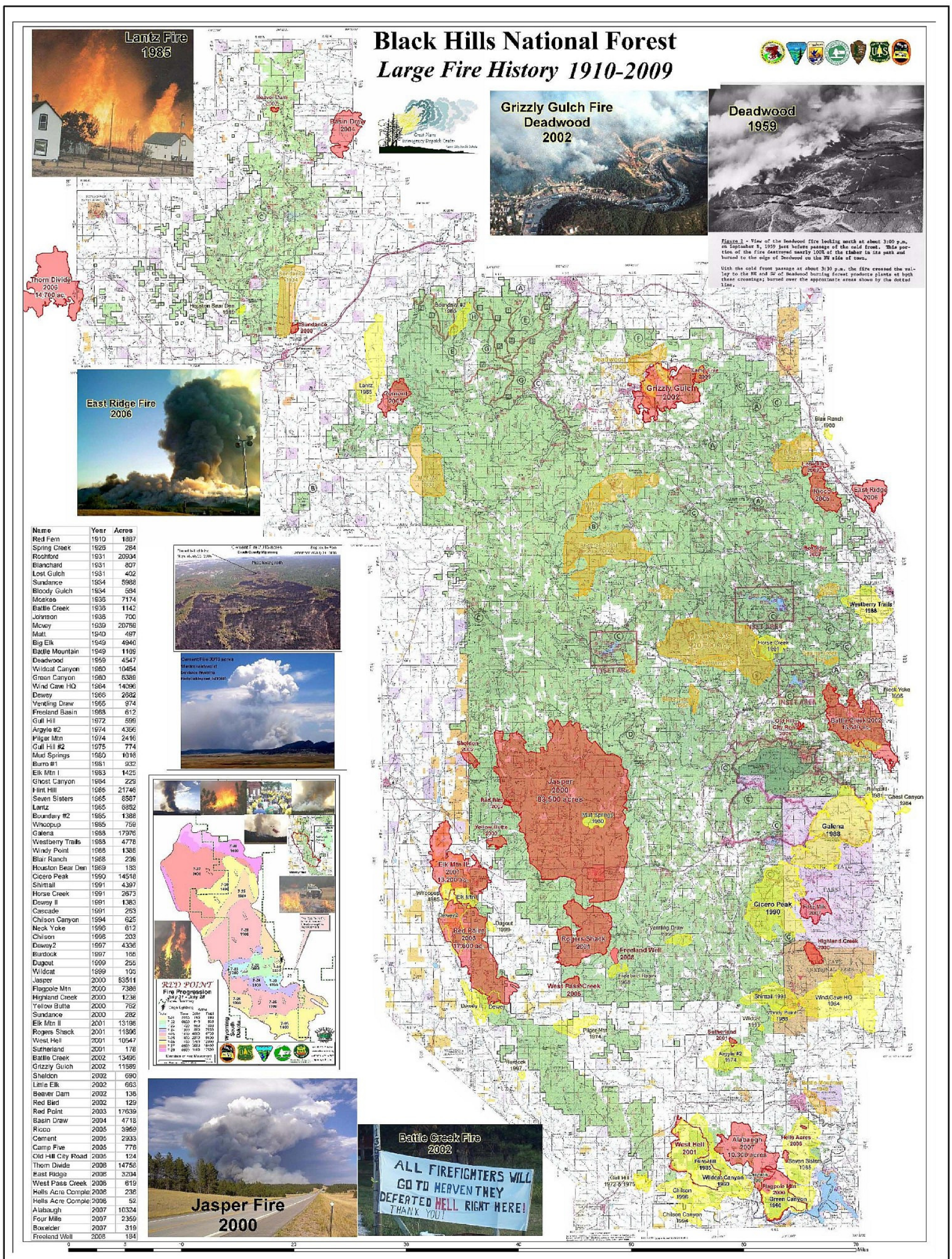
Map C – Large Fire History, 1910-2009

Map D – Wildland-Urban Interface (WUI). (May 5, 2010).

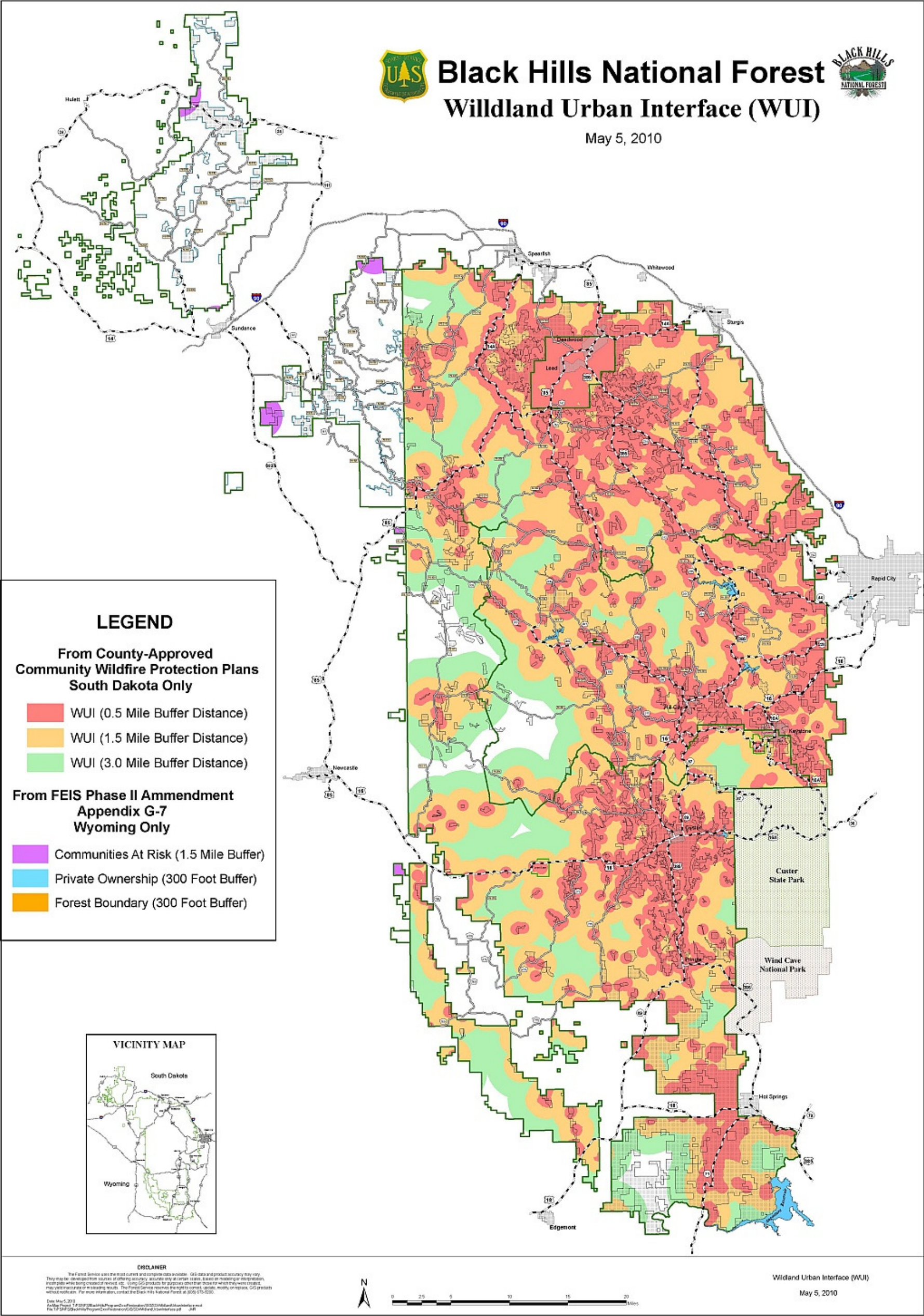




Map B



Map C



Map D